VERIFICATION OF TRANSLATION

I, Takahiro Suzuki, of ISONO INTERNATIONAL PATENT OFFICE, Sabo-kaikan Annex, 7-4, Hirakawa-cho 2-chome, Chiyoda-ku, Tokyo, Japan, am the translator of the documents attached and I swear and guarantee that the following is a translation with strict fidelity to the original Japanese application documents.

Signature of translator: Takahiro Suzuki

Takahiro Suzuki

Date: March 12, 2007

JAPAN PATENT OFFICE

This is to certify that the annexed is a true copy of the following application as filed with this Office.

Date of Application: March 17, 2003

Application Number: Japanese Patent Application No.2003-071221
[JP 2003-071221]

Applicant(s): HONDA MOTOR CO., LTD.

Date:

Commissioner,
Japan Patent Office

Yasuo Imai (Sealed)

Reference Number 2003-3059777

Patent Application No.2003-071221

【Name of Document】 Patent Application
【Reference Number】 H103054801
【Filing Date】 March 17, Heisei 15
【Addressed to】 Commissioner of Patent Office
【International Classification】 H01M 8/04
H01M 8/06
【Inventor】
【Domicile】 4-1, Chuo 1-chome, Wako-shi, Saitama, Japan
【Name】 Yasushi KANAI
【Inventor】
【Domicile】 4-1, Chuo 1-chome, Wako-shi, Saitama, Japan
【Name】 Akio YAMAMOTO
【Applicant】
【Identification Number】 000005326
【Name】 HONDA MOTOR CO., LTD.
【Attorney】
【Identification Number】 100064414
【Patent Attorney】
【Name】 Michizo ISONO
【Telephone Number】 03-5211-2488
【Indication of Official Fee】
【Number of Payment Ledger】 015392
【Amount】 21,000 Yen
【Filing Documents】
【Name of Documents】 Specification 1
【Name of Documents】 Drawings 1
【Name of Documents】 Abstract 1
【Number of General Power of Attorney】 9713945
【Request of Proof】 Yes

[Name of Document] Specification

[Title of the Invention] Exhaust Gas Processing Device for Fuel Cell

[Claims]

[Claim 1] An exhaust gas processing device for a fuel cell comprising:

an exhaust fuel diluter having a reservoir in which hydrogen gas purged from the fuel cell is retained and then mixed with cathode exhaust gas from the fuel cell and diluted prior to being discharged to an atmosphere;

an agitating gas pipe for introducing agitating gas which agitates the hydrogen gas retained in the reservoir;

an adjustment valve for adjusting an amount of agitating gas;

a hydrogen concentration detector for detecting a hydrogen concentration of emission gas discharged to the atmosphere; and

a controller for adjusting the adjustment valve based on a detection signal from the hydrogen concentration detector.

[Claim 2] An exhaust gas processing device for a fuel cell according to claim 1, wherein the controller controls a flow rate adjusting means to increase an amount of cathode exhaust gas in a case where an amount of agitating gas to be supplied to the exhaust fuel diluter is not greater than a lower limit value and the hydrogen concentration is determined to be higher than a predetermined value.

[Claim 3] An exhaust gas processing device for a fuel cell comprising:

an exhaust fuel diluter having a reservoir in which hydrogen gas purged from the fuel cell is retained and then mixed with cathode exhaust gas from the fuel cell and diluted prior to being discharged to an atmosphere;

an agitating gas pipe for introducing agitating gas which agitates the hydrogen gas retained in the reservoir; and

an adjustment valve for adjusting an amount of agitating gas;

wherein an introduction of agitating gas is controlled in response to an execution of purging from the fuel cell.

[Detailed Description of the Invention]

[0001]

[Technical Field to which the Invention Pertains]

The present invention relates to an exhaust gas processing device for a fuel cell,

which can dilute hydrogen purged from the fuel cell to a predetermined concentration and then discharge the diluted hydrogen to the atmosphere.

[0002]

[Prior Art]

In general, a fuel cell defines the cathode and the anode at both ends of a proton exchange membrane or polymer electrolyte membrane (PEM membrane) so that oxygen in the air is supplied to the cathode while hydrogen contained in a fuel gas is supplied to the anode to thereby generate electricity by the electrochemical reaction therebetween. In this field of the fuel cell, as a technique for diluting and discharging unreacted hydrogen, for example, Patent Reference 1 discloses that hydrogen discharged from the fuel cell is mixed with air in an exhaust fuel diluter and diluted hydrogen is discharged to the atmosphere.

[0003]

[Patent Reference 1]

Japanese Laid-open Patent Application No.11-191422 (paragraph number [0024] and FIG. 2)

[0004]

[Problem to be Solved]

However, according to the aforementioned technique, it is desired that the hydrogen concentration in emission gas is highly accurately controlled to exert the inherent performance of the exhaust fuel diluter in order to keep the hydrogen concentration in the emission gas that is discharged from the exhaust fuel diluter to the atmosphere not greater than a predetermined limit value and to dilute and process as much purged hydrogen as possible.

[0005]

In view of the above, the present invention seeks to provide an exhaust gas processing device for a fuel cell, which can sufficiently exert the inherent performance of the exhaust fuel diluter.

[0006]

[Means for Solving the Problem]

In order to solve the above problem, according to claim 1, there is provided an exhaust gas processing device for a fuel cell comprising: an exhaust fuel diluter having a reservoir in which hydrogen gas purged from the fuel cell is retained and then mixed with cathode exhaust gas from the fuel cell and diluted prior to being discharged to an atmosphere;

an agitating gas pipe for introducing agitating gas which agitates the hydrogen gas retained in the reservoir; an adjustment valve for adjusting an amount of agitating gas; a hydrogen concentration detector for detecting a hydrogen concentration of emission gas discharged to the atmosphere; and a controller for adjusting the adjustment valve based on a detection signal from the hydrogen concentration detector.

[0007]

With this construction of the exhaust gas processing device according to claim 1, when hydrogen gas retained in the reservoir is mixed with cathode exhaust gas and discharged to the external, the hydrogen concentration detector detects the hydrogen concentration of the emission gas. The controller then controls the adjustment valve based on a detection signal transmitted from the hydrogen concentration detector so as to increase or decrease the amount of agitating gas, thereby adjusting the amount of hydrogen contained in the emission gas. To be more specific, with increased amount of agitating gas hydrogen retained at the upper part of the reservoir is agitated to increase the amount of hydrogen contained in the emission gas. Meanwhile, with decreased amount of agitating gas the amount of hydrogen that is being agitated and is likely to flow upward of the reservoir is increased, so that the amount of hydrogen contained in the emission gas is decreased.

[0008]

According to the invention as claimed in claim 2, in the aforementioned exhaust gas processing device according to claim 1, the controller controls a flow rate adjusting means to increase the amount of cathode exhaust gas in a case where the amount of agitating gas to be supplied to the exhaust fuel diluter is not greater than a lower limit value and the hydrogen concentration is determined to be higher than a predetermined value.

[0009]

Herein, the term "flow rate adjusting means" indicates, for example, a compressor which can feed air in accordance with the rotational speed or a flow regulating valve which can adjust the flow rate.

[0010]

With this construction of the exhaust gas processing device according to claim 2, for example, in a case where the amount of agitating gas is decreased to decrease the amount of hydrogen contained in the emission gas because the hydrogen concentration detected by the hydrogen concentration detector is high, if it is impossible to decrease the amount of agitating

gas any longer, that is, in a condition equal to or lower than the lower limit value, the controller controls the flow rate adjusting means to increase the amount of cathode exhaust gas.

[0011]

According to the invention as claimed in claim 3, there is provided an exhaust gas processing device for a fuel cell including: an exhaust fuel diluter having a reservoir in which hydrogen gas purged from the fuel cell is retained and then mixed with cathode exhaust gas from the fuel cell and diluted prior to being discharged to an atmosphere; an agitating gas pipe for introducing agitating gas which agitates the hydrogen gas retained in the reservoir; and an adjustment valve for adjusting an amount of agitating gas. An introduction of agitating gas is controlled in response to an execution of purging from the fuel cell.

[0012]

With this construction of the exhaust gas processing device according to claim 3, when hydrogen is purged from the fuel cell, an introduction of agitating gas into the reservoir is controlled in response to the execution of purging. For example, if the adjustment valve is controlled to be closes in response to the execution of purging, the pressure within the reservoir lowers equal to or lower than a predetermined value, so that purged hydrogen is sufficiently drawn into the reservoir.

[0013]

[Preferred Embodiments of the Invention]

With reference to the accompanying drawings, a preferred embodiment of an exhaust gas processing device for a fuel cell according to the present invention will be described. Of those drawings to be referred to, FIG. 1 is a plan view illustrating an electric vehicle equipped with an exhaust gas processing device for a fuel cell according to the present invention, and FIG. 2 is a block diagram illustrating a fuel cell system with the exhaust gas processing device. FIG. 3 schematically explains movements of agitating air and purged hydrogen within the discharged fuel diluter. In particular, FIG. 3 schematically illustrates respective construction parts to explain movements of agitating air and purged hydrogen, and relative positions of these construction parts are not restricted to this specific embodiment. Especially, a discharged fuel diluter 6 and an exhaust gas pipe 14 may be formed such that the exhaust gas pipe 14 extends through the discharged fuel diluter 6 as illustrated in FIG. 2 or the exhaust gas pipe 14 is connected to the discharged fuel diluter 6 at the lower end thereof as illustrated in

FIG. 3.

[0014]

As shown in FIG. 1, an electric vehicle 1 equipped with a fuel cell (hereinafter simply referred to as a "vehicle") mounts a fuel cell system box 2 under a central part of the floor. A fuel cell system is arranged in the fuel cell system box 2, in order of a temperature regulator 3, a fuel cell stack 4, a humidifier 5, and a discharged fuel diluter 6 from the front to the rear of the vehicle 1. The fuel cell system further includes a non-illustrated radiator for cooling the fuel cell stack 4, a high pressure hydrogen storage tank 23 and a compressor (flow rate adjusting means) 21 for adjusting the amount of discharged air shown in FIG. 2, etc.

[0015]

As shown in FIG. 2, the fuel cell stack 4 generates electricity by an electrochemical reaction between hydrogen stored in the high pressure hydrogen storage tank 23 as a fuel and air supplied from the compressor 21 (hereinafter referred to as "supply air"). Connected at the lower part of the fuel cell stack 4 is an anode drain pipe 10 for discharging drainage, such as water, to be produced during the generation of electricity. Drainage is discharged into the discharged fuel diluter 6 through the anode drain pipe 10. A manually or automatically operated switch valve 12 is arranged in the anode drain pipe 10. By opening or closing the switch valve 12, water produced in the fuel cell stack 4 flows toward the discharged fuel diluter 6.

[0016]

At the anode side of the fuel cell stack 4, a hydrogen supply pipe 22 for feeding hydrogen from the high pressure hydrogen storage tank 23 is connected to the inlet, and a recirculation pipe (recirculation system) 7 for returning hydrogen to the fuel cell stack 4 is connected to the outlet. Connected to the recirculation pipe 7 is a purge pipe 8, through which impurities contained in hydrogen retained in the recirculation pipe 7 or hydrogen which contains water produced in the fuel cell struck 4 are discharged. Hydrogen in the recirculation pipe 7 is intermittently purged (discharged) into the discharged fuel diluter 6 when a purge valve 9 arranged in the purge pipe 8 is open and closed at a certain interval based on a signal from a controller 27 to be described later.

[0017]

At the cathode side of the fuel cell stack 4, an air supply pipe 24 for feeding supply air from the compressor 21 is connected to the inlet, and an exhaust gas pipe 14 for introducing

air discharged from the fuel cell stack 4 (hereinafter referred to as "discharged air (cathode exhaust gas)") to the external is connected to the outlet. The exhaust gas pipe 14 extends under the discharged fuel diluter 6 so that discharged air flowing through the exhaust gas pipe 14 is guided to the external flowing under the discharged fuel diluter 6. At least one suction hole 17 (two suction holes are shown in FIG. 2) is formed in the exhaust gas pipe 14. The suction hole 17 is for drawing mixture containing hydrogen or water within the discharged fuel diluter 6. An agitating gas pipe 19 is branched off from the exhaust gas pipe 14 at the upstream of the discharged fuel diluter 6 and extends to the upper part of the discharged fuel diluter 6. A part of discharged air flowing through the exhaust gas pipe 14 is guided to the upper part of the discharged fuel diluter 6 as agitating air. A back fire filter 15 is arranged at the outlet of the exhaust gas pipe 14.

[0018]

A humidifier 5 is arranged in the hydrogen supply pipe 22 at an appropriate position, and a humidifier drain pipe 11 is connected to the lower part of the humidifier 5 for discharging drainage such as water into the discharged fuel diluter 6. A manually or automatically operated switch valve 13 is arranged in the humidifier drain pipe 11, and by opening or closing the switch valve 13, drainage in the humidifier 5 flows toward the discharged fuel diluter 6. Although not shown in the drawings, the air supply pipe 24 is also provided with a humidifier 5, a humidifier drain pipe 11, and a switch valve 13, so that drainage in the humidifier 5 can be discharged into the discharged fuel diluter 6.

[0019]

The discharged fuel diluter 6 is a container having a reservoir, in which purged hydrogen that is intermittently purged from the recirculation pipe 7 is temporally retained. The discharged fuel diluter 6 is a main part of an exhaust gas processing device 25 to be described later. Provided in the bottom portion of the discharged fuel diluter 6 is a communication hole 6a (see FIG. 3) that is in communication with the suction hole 17 of the exhaust gas pipe 14.

[0020]

As shown in FIG. 3, the exhaust gas processing device 25 includes the discharged fuel diluter 6, the agitating gas pipe 19, the exhaust gas pipe 14, and the compressor 21. Further, the exhaust gas processing device 25 includes an adjustment valve 19a, an air amount detector 19b, a hydrogen concentration detector 26, and a controller 27. The adjustment valve 19a is

arranged in the agitating gas pipe 19 at an appropriate position. The adjustment valve 19a controls the opening degree based on a signal transmitted from the controller 27, thereby adjusting the amount of agitating air.

[0021]

The air amount detector 19b is provided in the interior of the adjustment valve 19a. The air amount detector 19b detects the opening degree of the valve to thereby detect the amount of agitating air introduced into the discharged fuel diluter 6, and outputs the detection signal to the controller 27. The hydrogen concentration detector 26 is provided at the outlet side of the exhaust gas pipe 14, specifically at the downstream of the suction hole 17. The hydrogen concentration detector 26 detects the hydrogen concentration of mixture made by mixing discharged air and hydrogen drawn from the suction hole 17 (hydrogen concentration after the dilution of discharged air), and outputs the detection signal to the controller 27.

[0022]

The controller 27 controls the opening degree of the adjustment valve 19a based on the detection signal from the hydrogen concentration detector 26, and also controls the rotational speed of the compressor 21 based on the detection signals from the air amount detector 19b and the hydrogen concentration detector 26. Further, the controller 27 transmits a signal to the purge valve 9 at a time when the fuel cell defectively generates electricity (decreased voltage generation) or at a predetermined time interval to open the purge valve 9, thereby discharging hydrogen. When the controller 27 transmits a signal to the purge valve 9, the controller 27 determines that hydrogen is purged, and controls the adjustment valve 19a in response to the execution of purging so as to control the introduction of agitating air into the discharged fuel diluter 6. To be more specific, the controller 27 performs a control according to the control flow shown in FIG. 4.

[0023]

With reference to FIGS. 3 and 4, method of processing purged hydrogen by the exhaust gas processing device 25 will be described.

At first, a determination is made as to whether hydrogen is purged from the recirculation pipe 7 (step S1). The purging process is repeatedly carried out at a time when the voltage of generated electricity lowers or at a predetermined time interval (e.g. at every 5 to 10 second). If purged hydrogen is detected in step S1 (Yes), the controller 27 closes the adjustment valve 19a so that a supply of agitating air to the discharged fuel diluter 6 is

stopped (step S2). By this operation, the pressure within the discharged fuel diluter 6 lowers equal to or lower than a predetermined value, so that purged hydrogen is sufficiently drawn into the discharged fuel diluter 6.

[0024]

If hydrogen is not purged in step S1 (No), the hydrogen concentration detector 26 detects the hydrogen concentration (step S3), and the controller 27 determines whether the detected hydrogen concentration is within a predetermined range, for example, in the range from 1 to 1.5 % (step S4). If the hydrogen concentration is within the predetermined range in step S4, the control is completed.

[0025]

If the hydrogen concentration is determined to be lower than the predetermined range in step S4, the controller 27 determines that hydrogen, the specific gravity of which is lower than air, retains at the upper part of the discharged fuel diluter 6 and thus the amount of hydrogen drawn from the suction hole 17 becomes smaller. In this instance, the controller 27 opens the adjustment valve 19a for a certain amount to increase the flow rate of agitating air introduced into the discharged fuel diluter 6 (step S5). Purged hydrogen is then drawn from the suction hole 17. Thereafter, operation returns to step S3 to detect the hydrogen concentration, and then to step S4 to determine whether the hydrogen concentration is within the predetermined range. If the hydrogen concentration increases to the predetermined range by the increased amount of agitating air, the control is completed.

[0026]

As shown in FIG. 4, if the hydrogen concentration is determined to be higher than the predetermined range in step S4, the controller 27 determines that too much hydrogen is drawn from the suction hole 17 because of agitating air. In this instance, the controller 27 closes the adjustment valve 19a for a certain amount to decrease the flow rate of agitating air introduced into the discharged fuel diluter 6 (step S6). Next, based on the detection signal from the air amount detector 19b, the controller 27 determines whether the flow rate of agitating air is not greater than the lower limit value (e.g. zero) (step S7). If the flow rate of agitating air is greater than the lower limit value (No), operation returns to step S3 to detect the hydrogen concentration, and then to step S4 to determine whether the hydrogen concentration is within the predetermined range.

[0027]

If the controller 27 determines that the flow rate of agitating air is not greater than the lower limit value (Yes) in step S7, the hydrogen concentration detector 26 detects the hydrogen concentration again (step S8) and a determination is made as to whether the hydrogen concentration is higher than a predetermined value (e.g. 1.5 %) (step S9). If the controller 27 determines that the hydrogen concentration is not greater than the predetermined value (No) in step S9, operation again returns to step S3 and step S4. However, because the hydrogen concentration is within the predetermined range in step S4, the control is completed.

[0028]

If the controller 27 determines that the hydrogen concentration is greater than the predetermined value (Yes) in step S9, because it is impossible to decrease the amount of agitating air any longer, the controller 27 increases the rotational speed of the compressor 21 so as to increase the amount of discharged air to be mixed with hydrogen that is introduced from the suction hole 17 (step S10). The hydrogen concentration is therefore decreased. When operation returns to step S3 and step S4, if the hydrogen concentration decreases to the predetermined range because of the increased discharged air, the control is completed.

[0029]

FIGS. 5 (a) and 5 (b) respectively show a time chart explaining changes in purged hydrogen and agitating air. As shown in the figures, a supply of agitating air is not permitted during purging (time intervals between T1 and T2 and between T3 and T4), and the amount of agitating air is increased or decreased according to the detection value of the hydrogen concentration at a time when the purging is not executed (time interval between T2 and T3). The hydrogen concentration is likely to increase greater than the predetermined value because a supply of agitating air is stopped (the amount of agitating air is zero) just after the purging is completed (T2, T4). Therefore, the amount of agitating air gradually increases. Herein, FIG. 5 (a) shows the instance where a linear valve is used as the adjustment valve 19a. In this instance, a supply of agitating air increases continuously. Meanwhile, FIG. 5 (b) shows the instance where a duty valve is used as the adjustment valve 19a. In this instance, the ON/OFF ratio of the valve 19a increases gradually.

[0030]

According to the exhaust gas processing device of this embodiment, the following advantages can be obtained.

(1) Because the controller 27 controls the adjustment valve 19a based on the detection

signal from the hydrogen concentration detector 26 so that the amount of hydrogen drawn into the exhaust gas pipe 14 can be adjusted by way of controlling the amount of agitating air, it is possible to control the hydrogen concentration of mixture that is discharged to the external within the predetermined range. To be more specific, by retaining the hydrogen concentration of hydrogen that is discharged to the atmosphere not greater than the predetermined lower limit value and by mixing and diluting as much purged hydrogen as possible, it is possible to improve the threshold value of the amount of hydrogen that is purged from the fuel cell. Further, because increased amount of hydrogen can be purged off when generation of electricity is unstable such as in the case of decreased voltage generation or start up of generation of electricity, it is possible to control generation of electricity in a stable manner.

[0031]

(2) Even if controlling the adjustment valve 19a does not allow the hydrogen concentration of mixture that is discharged to the external to be lower, because the amount of discharged air can be increased by controlling the compressor 21, it is possible to control the hydrogen concentration of the mixture within the predetermined range.

(3) Because the adjustment valve 19a can be controlled in response to the operation of the purge valve 9 so as to decrease the pressure within the discharged fuel diluter 6, it is possible to sufficiently introduce purged hydrogen into the discharged fuel diluter 6.

[0032]

While the present invention has been described in detail with reference to specific embodiments thereof, it will be apparent to one skilled in the art that various changes and modifications may be made without departing from the scope of the claims.

In this embodiment, discharged air from the fuel cell is used as agitating air. However, the present invention is not limited to this example, and supply air may be used as agitating air.

[0033]

[Effect of the Invention]

According to the invention as recited in claim 1, the controller controls the adjustment valve based on a detection signal from the hydrogen concentration detector so as to adjust the amount of hydrogen contained in the emission gas. Therefore, it is possible to control the hydrogen concentration of the emission gas to be discharge to the atmosphere within a

predetermined range, and as the result, to make the exhaust fuel diluter sufficiently exert the inherent performance.

[0034]

According to the invention as recited in claim 2, even if the control of the adjustment valve does not perform to decrease the hydrogen concentration of the emission gas to be discharged to the atmosphere, the amount of cathode exhaust gas can be increased by the control of the flow rate adjusting means. Therefore, the hydrogen concentration of the emission gas is reliably controlled within the predetermined range.

[0035]

According to the invention as recited in claim 3, the purged hydrogen is sufficiently drawn into the exhaust fuel diluter by controlling the introduction of the agitating gas, and as the result, it is possible to make the exhaust fuel diluter sufficiently exert the inherent performance.

[Brief Description of the Drawings]

[FIG. 1]

FIG. 1 is a plan view illustrating an electric vehicle equipped with an exhaust gas processing device for a fuel cell according to the present invention;

[FIG. 2]

FIG. 2 is a block diagram illustrating a fuel cell system with the exhaust gas processing device;

[FIG. 3]

FIG. 3 schematically explains movements of agitating air and purged hydrogen within the exhaust fuel diluter;

[FIG. 4]

FIG. 4 is a control flow showing manner of processing purged hydrogen by the exhaust gas processing device according to the present invention;

[FIG. 5]

FIG. 5 (a) is a time chart explaining changes in agitating air and purged hydrogen that are adjusted by adjustment valves according to one embodiment, and FIG. 5 (b) is a time chart explaining changes in agitating air and purged hydrogen that are adjusted by adjustment valves according to another embodiment.

[Description of Reference Numerals]

4	fuel cell stack
6	discharged fuel diluter
7	recirculation pipe (recirculation system)
14	exhaust gas pipe
17	suction hole
19	agitating gas pipe
19a	adjustment valve
19b	air amount detector
21	compressor (flow rate adjusting means)
25	exhaust gas processing device
26	hydrogen concentration detector
27	controller

[Name of Document] Abstract

[Abstract]

[Problems] To provide an exhaust gas processing device for a fuel cell, which can sufficiently exert the inherent performance of the exhaust fuel diluter.

[Means for Solution] An exhaust gas processing device 25 for a fuel cell includes: an exhaust fuel diluter 6 into which hydrogen intermittently purged from a recirculation pipe is stored; an agitating gas pipe 19 for introducing a part of discharged air from the fuel cell 4 as an agitating air into an upper part of the exhaust fuel diluter 6; and an exhaust gas pipe 14 having a suction hole 17 for drawing hydrogen within the exhaust fuel diluter 6. Further, the exhaust gas processing device 25 includes: an adjustment valve 19a for adjusting the amount of agitating gas; a hydrogen concentration detector 26 for detecting the hydrogen concentration of the mixture gas made by mixing the discharged air and hydrogen drawn from the suction hole 17; and a controller 27 for controlling the adjustment valve 19a based on a detection signal from the hydrogen concentration detector 26.

[Selected Figure] FIG. 3

FIG.1

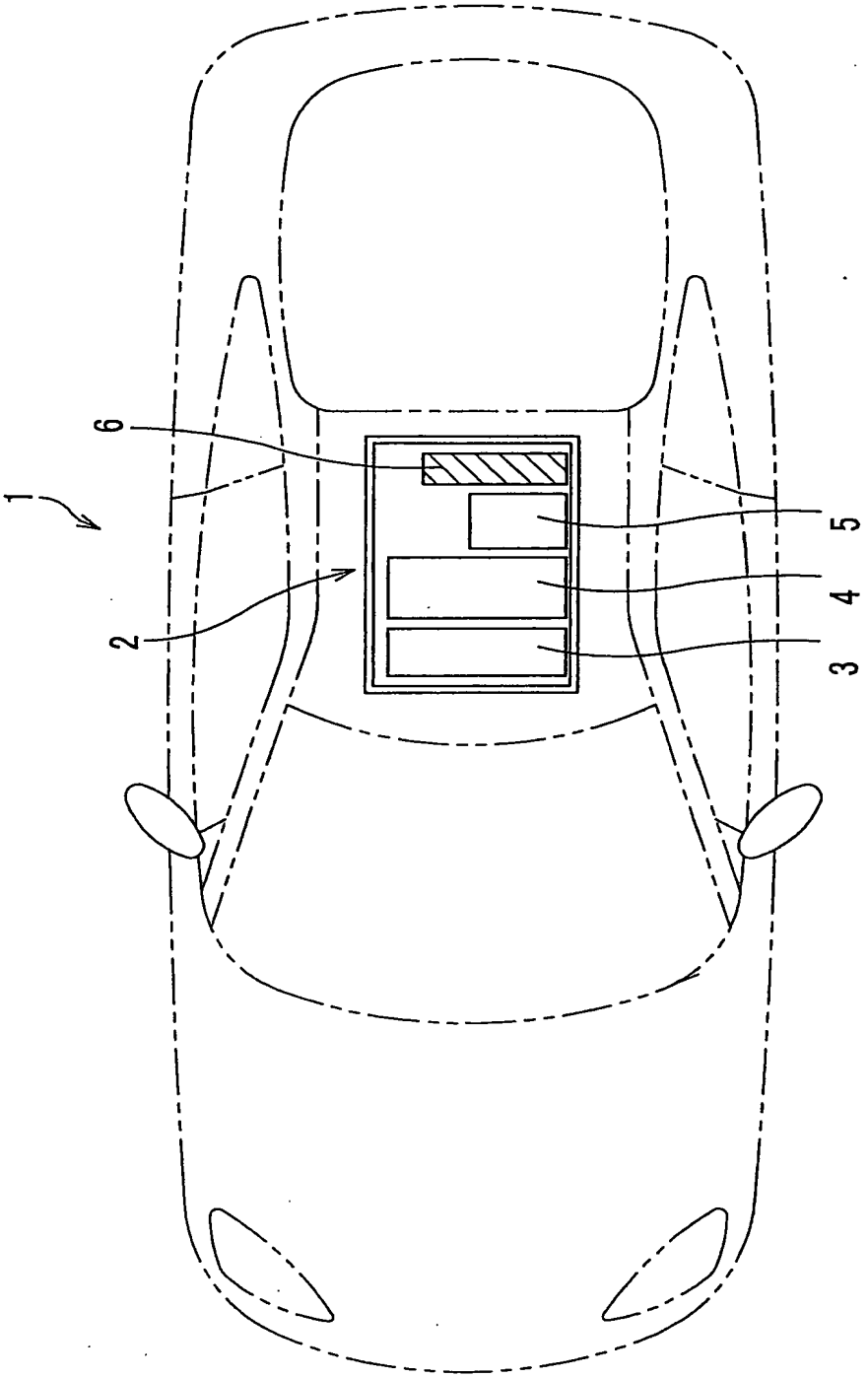


FIG.2

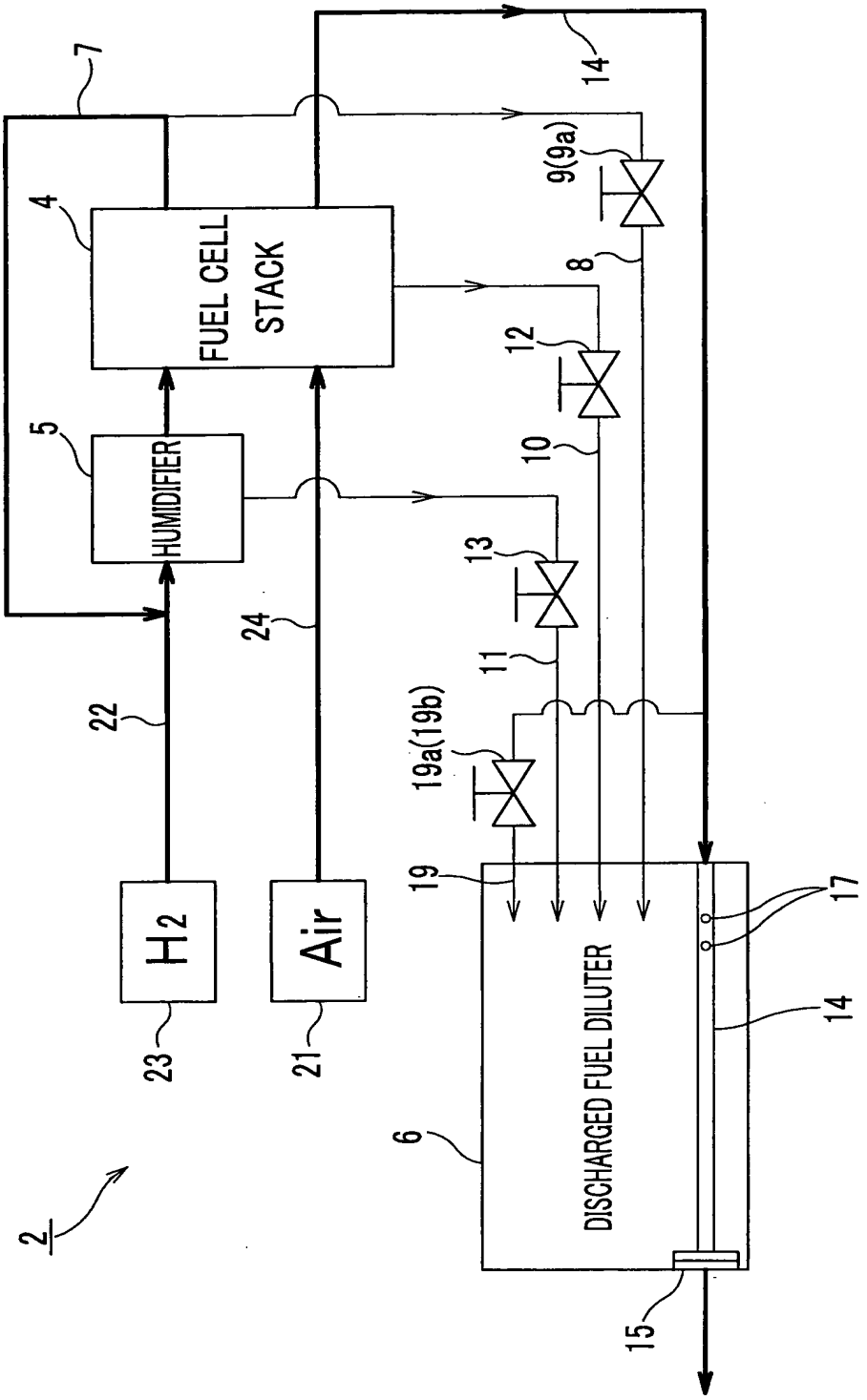

2
H2
Air
23
21
22
24
HUMIDIFIER
5
FUEL CELL STACK
4
7
14
9(9a)
8
12
10
13
11
19a(19b)
19
6
DISCHARGED FUEL DILUTER
17
14
15

FIG.3

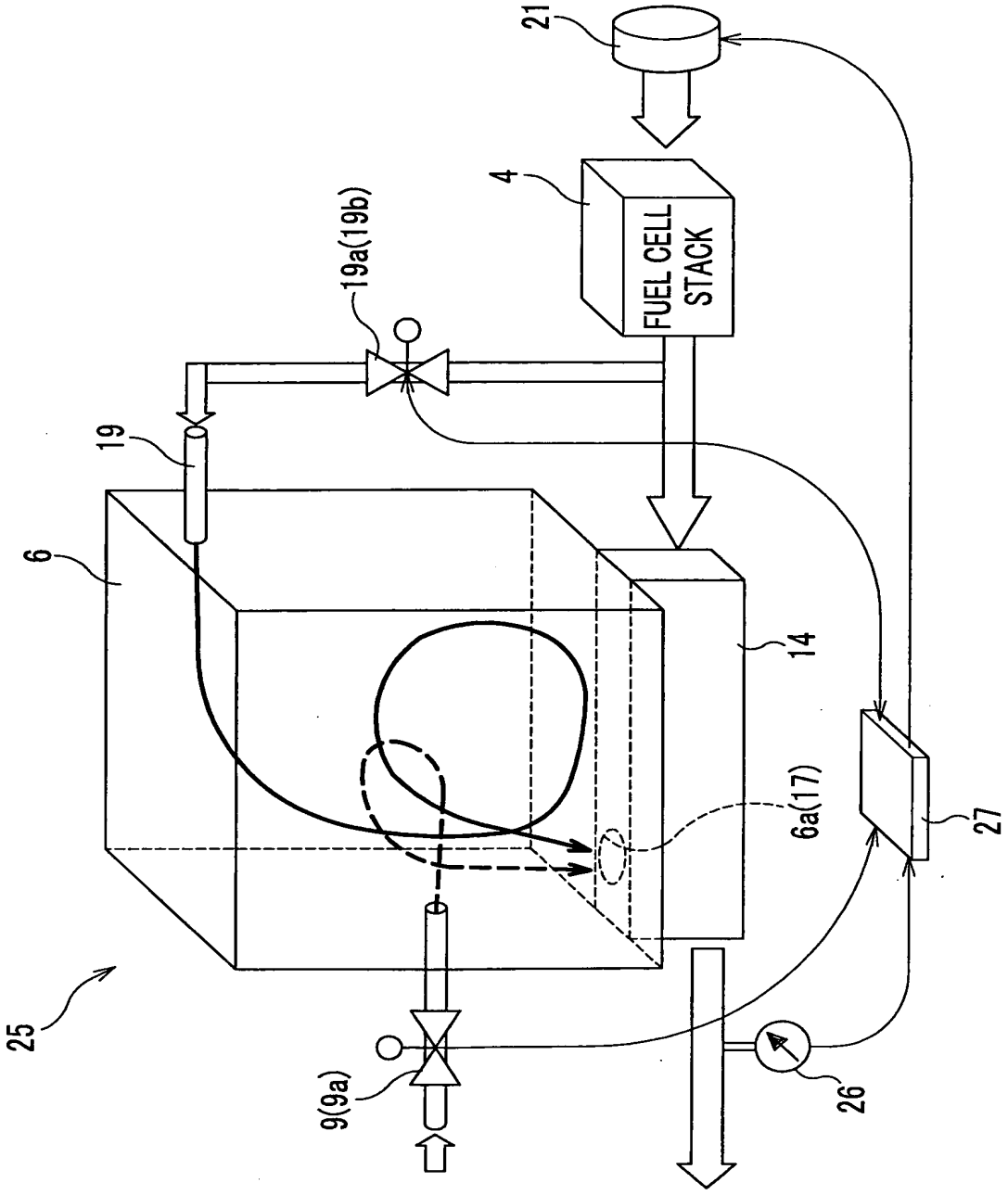


FIG.4

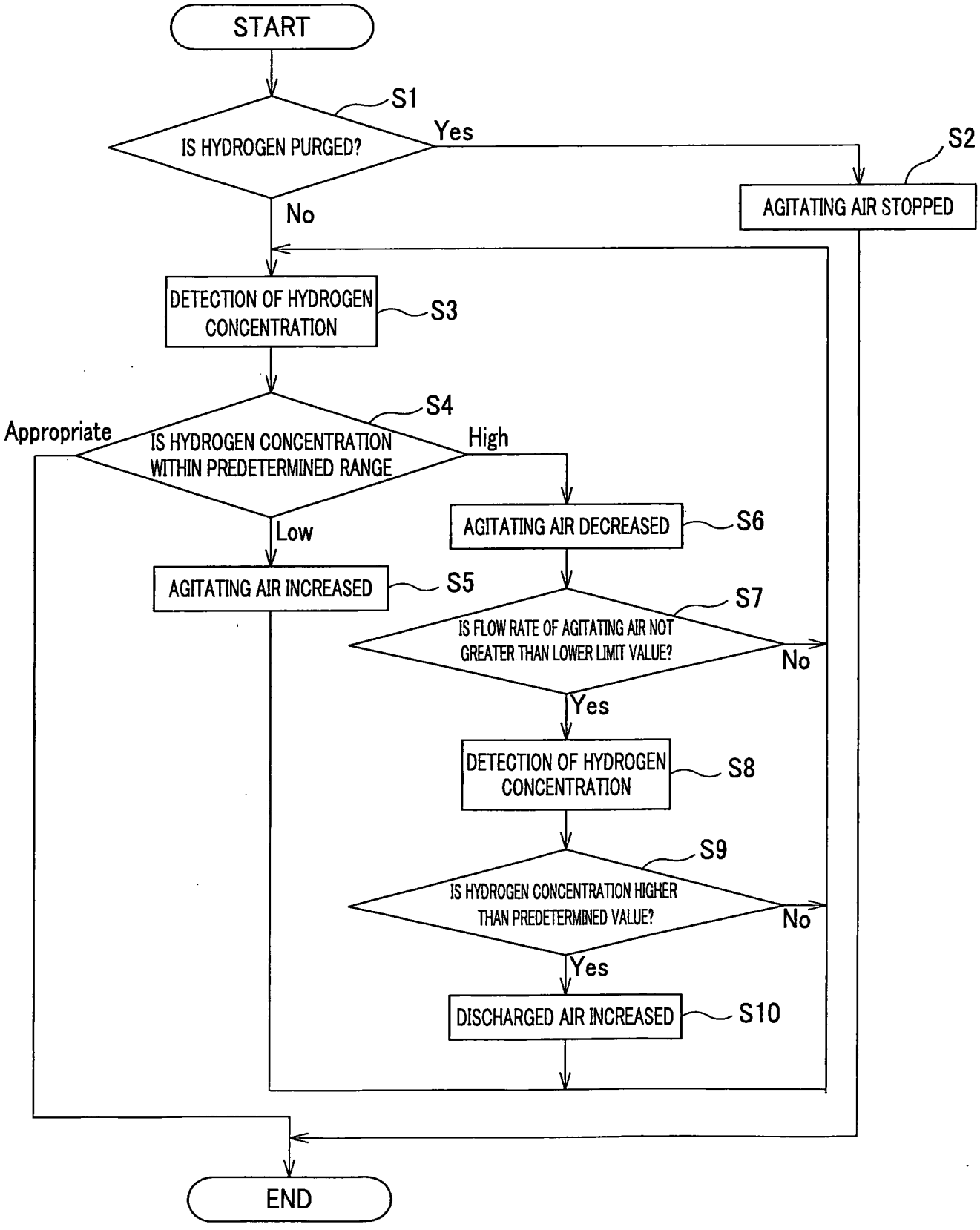
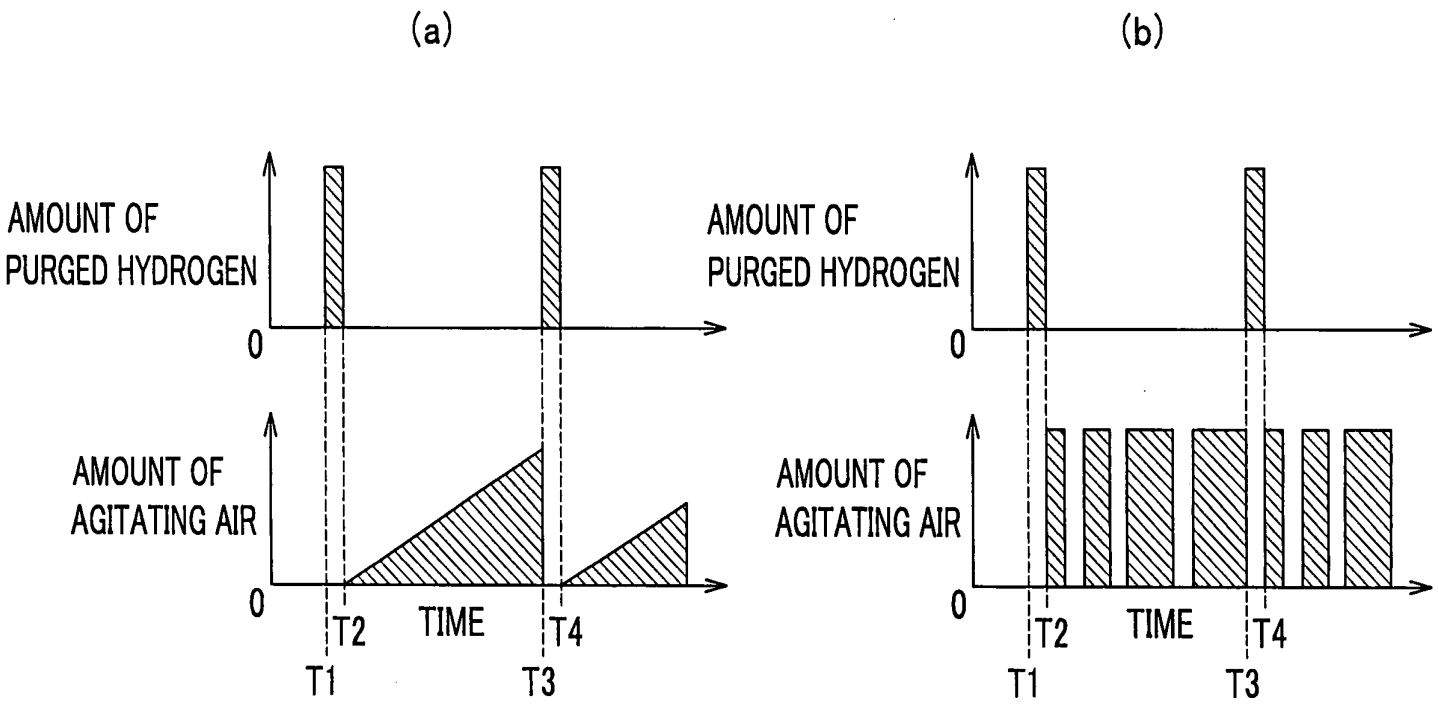

START
S1
IS HYDROGEN PURGED?
Yes
S2
AGITATING AIR STOPPED
No
DETECTION OF HYDROGEN CONCENTRATION
S3
S4
Appropriate
IS HYDROGEN CONCENTRATION WITHIN PREDETERMINED RANGE
High
AGITATING AIR DECREASED
S6
Low
AGITATING AIR INCREASED
S5
S7
IS FLOW RATE OF AGITATING AIR NOT GREATER THAN LOWER LIMIT VALUE?
No
Yes
DETECTION OF HYDROGEN CONCENTRATION
S8
S9
IS HYDROGEN CONCENTRATION HIGHER THAN PREDETERMINED VALUE?
No
Yes
DISCHARGED AIR INCREASED
S10
END

FIG.5


(a)
AMOUNT OF
PURGED HYDROGEN
0
AMOUNT OF
AGITATING AIR
0
T1
T2
TIME
T3
T4
(b)
AMOUNT OF
PURGED HYDROGEN
0
AMOUNT OF
AGITATING AIR
0
T1
T2
TIME
T3
T4

VERIFICATION OF TRANSLATION

I, Takahiro Suzuki, of ISONO INTERNATIONAL PATENT OFFICE, Sabo-kaikan Annex, 7-4, Hirakawa-cho 2-chome, Chiyoda-ku, Tokyo, Japan, am the translator of the documents attached and I swear and guarantee that the following is a translation with strict fidelity to the original Japanese application documents.

Signature of translator: Takahiro Suzuki

Takahiro Suzuki

Date: March 12, 2007

JAPAN PATENT OFFICE

This is to certify that the annexed is a true copy of the following application as filed with this Office.

Date of Application: October 17, 2002

Application Number: Japanese Patent Application No.2002-302739
[JP 2002-302739]

Applicant(s): HONDA MOTOR CO., LTD.

Date:

Commissioner,
Japan Patent Office

Yasuo Imai (Sealed)

Reference Number 2003-3059775

Patent Application No.2002-302739

【Name of Document】 Patent Application
【Reference Number】 H102267801
【Filing Date】 October 17, Heisei 14
【Addressed to】 Commissioner of Patent Office
【International Classification】 H01M 8/04
【Inventor】
【Domicile】 4-1, Chuo 1-chome, Wako-shi, Saitama, Japan
【Name】 Yasushi KANAI
【Inventor】
【Domicile】 4-1, Chuo 1-chome, Wako-shi, Saitama, Japan
【Name】 Hideo NUMATA
【Applicant】
【Identification Number】 000005326
【Name】 HONDA MOTOR CO., LTD.
【Attorney】
【Identification Number】 100064414
【Patent Attorney】
【Name】 Michizo ISONO
【Telephone Number】 03-5211-2488
【Indication of Official Fee】
【Number of Payment Ledger】 015392
【Amount】 21,000 Yen
【Filing Documents】
【Name of Documents】 Specification 1
【Name of Documents】 Drawings 1
【Name of Documents】 Abstract 1
【Number of General Power of Attorney】 9713945
【Request of Proof】 Yes

[Name of Document] Specification

[Title of the Invention] Exhaust Gas Processing Device for Fuel Cell

[Claims]

[Claim 1] An exhaust gas processing device for a fuel cell, in which hydrogen gas purged from the fuel cell is introduced through an inlet, retained in a reservoir, mixed with cathode exhaust gas from the fuel cell and diluted in the reservoir, and discharged to an atmosphere, the exhaust gas processing device comprising:

an agitating gas introduction inlet provided at an upper part of the reservoir,

wherein cathode exhaust gas to be supplied to the fuel cell is branched off and then supplied to the agitating gas introduction inlet.

[Detailed Description of the Invention]

[0001]

[Technical Field to which the Invention Pertains]

The present invention relates to an exhaust gas processing device for a fuel cell, and more particularly to an exhaust gas processing device for a fuel cell, which processes hydrogen purged from a fuel cell system where hydrogen is utilized as a fuel for a power source of an electric vehicle.

[0002]

[Prior Art]

In a fuel cell system using such a fuel cell as a power source for an electric vehicle, and in cases, for example, where pure hydrogen (herein after simply referred to "hydrogen") is used as fuel, a recirculation system is adopted for the purpose of improving utilization efficiency of hydrogen to be supplied to the fuel cell (see, for example, Patent Reference 1). To recirculate hydrogen, the recirculation system may be provided with an ejector which generates negative pressure for sucking hydrogen or a vacuum pump.

[0003]

[Patent Reference 1]

Japanese Laid-open Patent Application No.6-275300 (see Page 4 and FIG. 1)

[0004]

[Problem to be Solved]

During long-term recirculation of hydrogen, the concentration of impurities such as nitrogen increases in the recirculation system, leading to deterioration in generation efficiency.

Also, moisture retained in the fuel cell system makes a flow of hydrogen clogged in the anode pipe system. For this reason, purging is required to discharge impurities such as nitrogen and water to the atmosphere. However, because hydrogen is filled in the anode pipe system, high concentration hydrogen is also discharged to the external during the purging. In order to prevent hydrogen (purged hydrogen) from being discharged to the atmosphere, purged hydrogen is introduced into an exhaust fuel diluter and mixed with cathode exhaust gas. Therefore, purged hydrogen is diluted to a lower concentration and then discharged to the atmosphere.

However, in a case where purged hydrogen that is discharged to the atmosphere is intermittently fed to the exhaust fuel diluter, because the concentration fluctuation of purged hydrogen in the exhaust fuel diluter becomes greater with elapse of the time, the concentration fluctuation of purged hydrogen that is mixed with cathode exhaust gas and diluted prior to being discharged to the atmosphere also becomes greater.

Patent Reference 1 is silent as to the technical concept for diluting hydrogen to be purged prior to discharging the same to the atmosphere.

[0005]

In view of the above, the present invention seeks to provide an exhaust gas processing device for a fuel cell, which can prevent an increase in the concentration fluctuation of the purged hydrogen to be discharged to the atmosphere with elapse of the time, even in a case where the purged hydrogen is introduced intermittently into the exhaust fuel diluter.

[0006]

[Means for Solving the Problem]

In order to solve the above problem, according to claim 1, there is provided an exhaust gas processing device for a fuel cell, in which hydrogen gas purged from the fuel cell is introduced through an inlet, retained in a reservoir, mixed with cathode exhaust gas from the fuel cell and diluted in the reservoir, and discharged to an atmosphere. The exhaust gas processing device comprises an agitating gas introduction inlet provided at an upper part of the reservoir, wherein cathode exhaust gas to be supplied to the fuel cell is branched off and then supplied to the agitating gas introduction inlet.

[0007]

With this construction of the exhaust gas processing device according to claim 1,

anode gas that is temporally retained in the reservoir is mixed with and diluted by cathode exhaust gas that is fed to the reservoir, so that the concentration fluctuation within the reservoir becomes smaller. This results in small concentration change of anode gas that is mixed with and diluted by cathode exhaust gas and then discharged to the atmosphere.

Further, cathode gas with a relatively high specific gravity is introduced from the agitating gas introduction inlet provided at an upper part of the reservoir, so that the cathode gas flows downward toward a lower part of the reservoir. Therefore, the cathode gas is mixed with hydrogen with a low specific gravity that is likely to flow upward of the reservoir.

[0008]

[Preferred Embodiments of the Invention]

With reference to the accompanying drawings, a preferred embodiment of an exhaust gas processing device for a fuel cell according to the present invention will be described.

[0009]

Of those drawings to be referred to, FIG. 1 is a plan view illustrating an electric vehicle equipped with an exhaust gas processing device for a fuel cell according to the present invention, and FIG.2 is a block diagram illustrating a fuel cell system box according to the present invention.

[0010]

As shown in FIG. 1, an electric vehicle 1 equipped with a fuel cell (hereinafter simply referred to as a "vehicle") mounts a fuel cell system box 2 under a central part of the floor. A fuel cell system is arranged in the fuel cell system box 2, in order of a temperature regulator 3, a fuel cell stack 4, a humidifier 5, and an exhaust fuel diluter 6 from the front to the rear of the vehicle 1. The fuel cell system further includes a non-illustrated radiator for cooling the fuel cell stack 4, a high pressure hydrogen storage tank, etc.

[0011]

The fuel cell stack 4 generates electricity by feeding hydrogen stored in the high pressure hydrogen storage tank as a fuel and air taken from the external of the vehicle 1, so as to drive the vehicle 1. The fuel cell stack 4 generates product water (hereinafter simply referred to as "water") during the generation of electricity. To reliably operate the fuel cell stack 4, the temperature regulator 3 adjusts temperatures of hydrogen and air that are fed to the fuel cell stack 4, and the humidifier 5 humidifies hydrogen and air that are fed to the fuel cell stack 4. The discharged fuel diluter 6 is an exhaust gas processing device for a fuel

according to the present invention, in which discharged purged hydrogen from the anode piping system is retained, and thereafter mixed with and diluted by discharged air prior to being discharge to the atmosphere together with water.

[0012]

In order to improve the utilization efficiency (fuel economy), hydrogen once used in the fuel cell stack 4 is returned to the upstream of the humidifier 5 through a recirculation pipe7 to form a recirculation system. Further, because the concentration of impurities becomes higher or water produced by the generation of electricity retains in the fuel cell stack 4 after a long-term recirculation of hydrogen, in order to purge such hydrogen and water, a purge pipe 8 branched off from the recirculation pipe 7 is connected to the discharged fuel diluter 6. A switch valve 9 that is automatically or manually operated is provided in the purge pipe 8. The purge pipe 8 is normally closed, but is open during purging.

Further, in order to dilute and discharge drainage from the anode of the fuel cell stack 4 and drainage from the humidifier 5, an anode drain pipe 10 and a humidifier drain pipe 11 are connected to the discharged fuel diluter 6. A switch valve 12, 13 that is automatically or manually operated is provided in the anode drain pipe 10 and the humidifier drain pipe 11, respectively.

Further, in order to discharge cathode exhaust gas from the fuel cell stack 4, a cathode exhaust gas pipe 14 is connected to the discharged fuel diluter 6.

[0013]

The fuel cell system box 2 is constructed accordingly. Purged hydrogen discharged into the exhaust fuel diluter 6 retains in the diluter 6 for a while and disperses with its volume expanded. Because the cathode exhaust gas pipe 14 extends through the exhaust fuel diluter 6 and discharged air flows in the cathode exhaust gas pipe 14, the purged hydrogen retained in the exhaust fuel diluter 6 is drawn from suction holes 17, 17 and is mixed with discharged air. The purged hydrogen is therefore diluted to a lower concentration and is discharged to the atmosphere. Condensed water contained in discharged air from the humidifier 5 or the fuel cell stack 4 is also discharged together with discharged air. A reference numeral 15 denotes a back fire filter.

[0014]

With reference to FIG. 3, the exhaust gas processing will be described in detail.

The discharged fuel diluter 6 is a box-like container having a wall 16. Provided at

the upper part of the wall 16 is an agitating gas introduction inlet 19 for introducing cathode gas (see Air shown in FIG. 2) that is partly branched off from cathode gas before feeding to the fuel cell stack 4. Further, an inlet 20 is provided in the wall 16 at a position lower than the agitating gas introduction inlet 19, and purged hydrogen discharged from the purge pipe 8, the anode drain pipe 10, and the humidifier drain pip 11 (FIG. 2) are combined and introduced from the inlet 20. The discharged fuel diluter 6 forms therein a reservoir 18 for retaining discharged hydrogen that is introduced from the inlet 20.

A cathode exhaust gas pipe 14, through which discharged air from the cathode exhaust gas pipe system flows, extends horizontally through the walls 16, 22 at the lower part of the discharged fuel diluter 6. The diameter of the exhaust gas pipe 14 is smaller within the reservoir 18 than the diameter at the upstream of the discharged fuel diluter 6. The outlet 23 opens to the atmosphere. Suction holes 17, 17 are formed in the cathode exhaust gas pipe 14 at a position close to the wall 16. The suction holes 17, 17 are for sucking and mixing purged hydrogen. In this preferred embodiment, two suction holes 17, 17 are formed to improve the suction efficiency. However, the number of suction holes 17 may vary to the suitable number.

The pressure of cathode gas introduced from the agitating gas introduction inlet 19 to the reservoir 18 is set to be slightly higher than the pressure of cathode exhaust gas flowing through the cathode exhaust gas pipe 14.

[0015]

According to this discharged fuel diluter 6, high concentration purged hydrogen (anode gas) that is introduced from the anode pipe system (the purge pipe 8, the anode drain pipe 10, and the humidifier drain pipe 11) through the inlet 20 and into the reservoir 18 retains in the reservoir 18 with its volume expanded. At the same time, the cathode gas introduced from the agitating gas introduction inlet 19 agitates and dilutes the purged hydrogen, leading to decreased deviation of the concentration within the reservoir 18.

By horizontally exhausting cathode gas, the specific gravity of which is higher than purged hydrogen, from the agitating gas introduction inlet 19 provided at the upper part of the reservoir 18, and by introducing purged hydrogen, the specific gravity of which is low and which is likely to flow upward of the reservoir 18, from the inlet 20 positioned lower than the agitating gas introduction inlet 19, cathode gas flows against the opposite wall 22 and flows downward of the reservoir 18. Therefore, cathode gas and purged hydrogen are sufficiently

agitated and mixed together.

Next, together with water retained in the reservoir 18, high pressure purged hydrogen within the reservoir 18 is drawn from the suction holes 17, 17 that are provided in the cathode exhaust gas pipe 14 where cathode discharged air with a high flow velocity and with a low pressure is flowing, into the cathode exhaust gas pipe 14. The purged hydrogen is then mixed with and diluted by the cathode discharged air flowing through the cathode exhaust gas pipe 14 at a high speed, and is discharged to the atmosphere through the outlet 23 in a manner drawn by a flow of the cathode discharged air. Therefore, the purged hydrogen is sufficiently diluted prior to being discharged to the atmosphere.

In this event, change in the concentration of purged hydrogen at the outlet (cathode gas outlet) 23 is shown by the line A of FIG. 4. Even if purged hydrogen is intermittently introduced into the reservoir 18, not like the change B in the concentration of purged hydrogen in the conventional diluter, it is possible to prevent high concentration purged hydrogen from being discharged to the atmosphere. Therefore, when compared with the conventional diluter, it is possible to discharge relatively stable purged hydrogen without a large concentration change.

[0016]

[Effect of the Invention]

As described previously, in the exhaust gas processing device according to claim 1, anode gas that is temporally retained in the reservoir is mixed with and diluted by cathode exhaust gas that is fed to the reservoir, so that the concentration fluctuation within the reservoir becomes smaller. This results in small concentration change of anode gas that is mixed with and diluted by cathode exhaust gas and then discharged to the atmosphere.

Further, cathode gas with a relatively high specific gravity is introduced from the agitating gas introduction inlet provided at an upper part of the reservoir, so that the cathode gas flows downward toward a lower part of the reservoir. Therefore, the cathode gas is mixed with hydrogen with a low specific gravity that is likely to flow upward of the reservoir.

[Brief Description of the Drawings]

[FIG. 1]

FIG. 1 is a plan view illustrating an electric vehicle equipped with an exhaust gas processing device for a fuel cell according to the present invention.

[FIG. 2]

FIG.2 is a block diagram illustrating a fuel cell system box according to the present invention.

[FIG. 3]

FIG. 3 is a sectional view of the exhaust gas processing device.

[FIG. 4]

FIG. 4 is a graph explaining a change in concentration of purged hydrogen with elapse of time, at the cathode gas discharging portion of the exhaust gas processing device.

[Description of Reference Numerals]

1	electric vehicle (vehicle)
2	fuel cell system box
4	fuel cell stack
6	exhaust fuel diluter (exhaust gas processing device for fuel cell)
7	recirculation pipe
10	anode drain pipe
11	humidifier drain pipe
14	cathode exhaust gas pipe
17	suction hole
18	reservoir
19	agitating gas introduction inlet
20	inlet
23	cathode gas outlet

[Name of Document] Abstract

[Abstract]

[Problems] To provide an exhaust gas processing device for a fuel cell, which can prevent an increase in the concentration fluctuation of the purged hydrogen to be discharged to the atmosphere with elapse of the time, even in a case where the purged hydrogen is introduced intermittently into the exhaust fuel diluter.

[Means for Solution] An exhaust gas processing device 6 for a fuel cell, in which hydrogen gas purged from the fuel cell is introduced through an inlet 20, retained in a reservoir 18, mixed with cathode exhaust gas from the fuel cell and diluted in the reservoir 18, and discharged to an atmosphere, is provided. The exhaust gas processing device 6 includes an agitating gas introduction inlet 19 provided at an upper part of the reservoir 18, and cathode exhaust gas to be supplied to the fuel cell is branched off and then supplied to the agitating gas introduction inlet 19.

[Selected Figure] FIG. 3

FIG.1

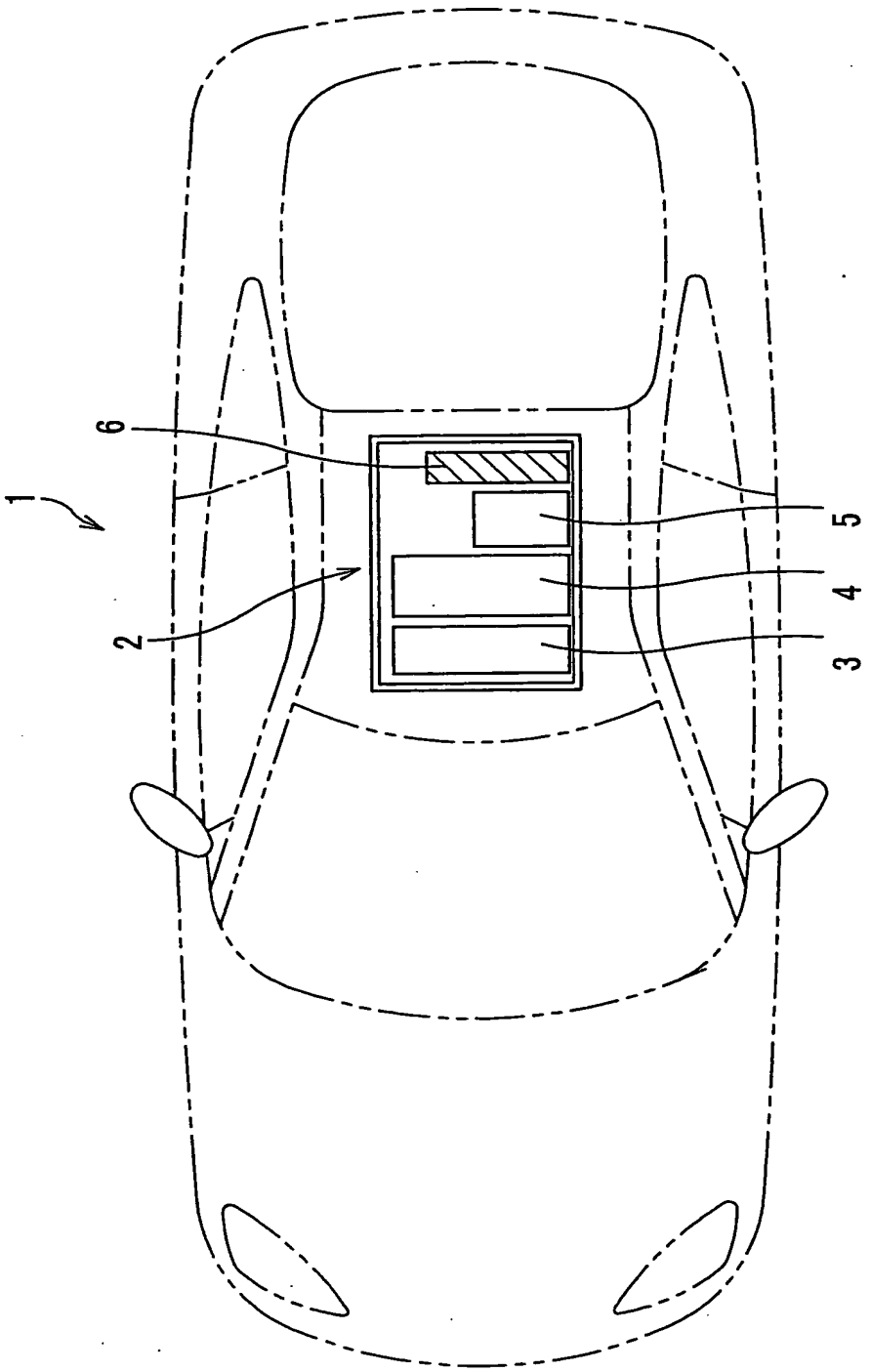


FIG.2

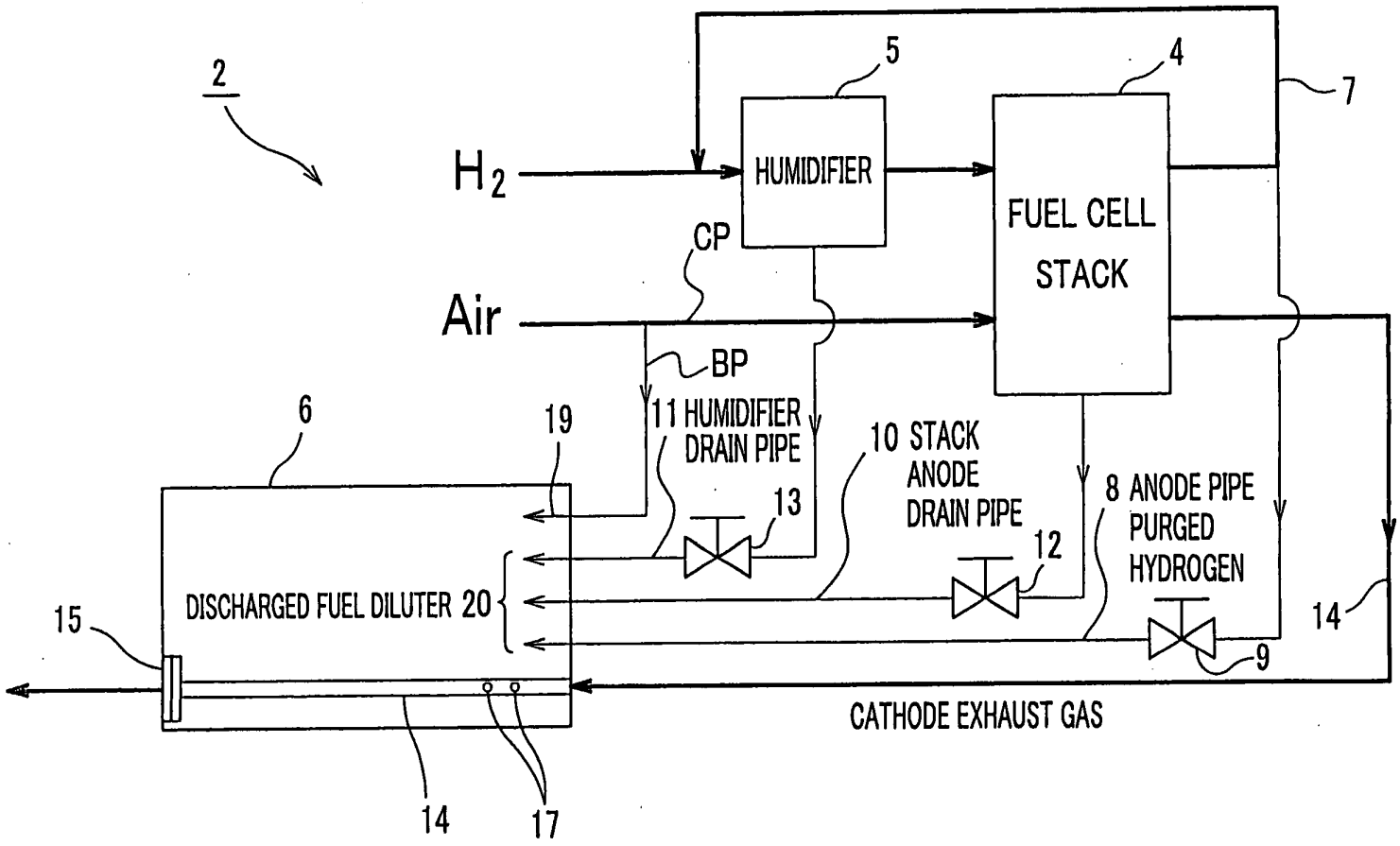

2
5
4
7
H_2
HUMIDIFIER
FUEL CELL STACK
CP
Air
BP
6
19
11 HUMIDIFIER DRAIN PIPE
10 STACK ANODE DRAIN PIPE
8 ANODE PIPE PURGED HYDROGEN
13
12
DISCHARGED FUEL DILUTER 20
15
14
9
CATHODE EXHAUST GAS
14
17

FIG.3

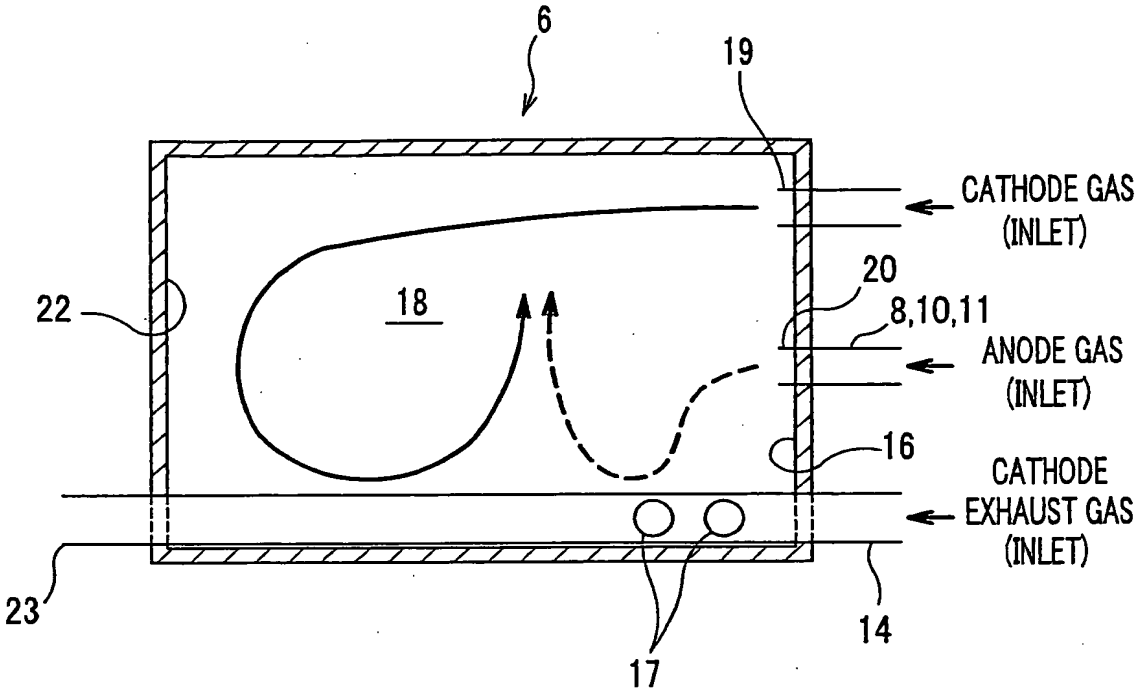
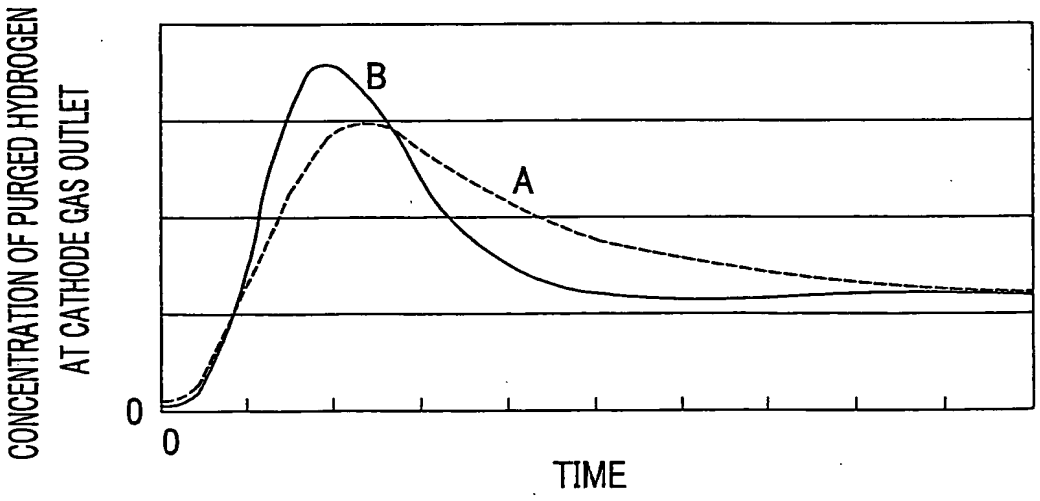

6
19
CATHODE GAS
(INLET)
20
22
18
8,10,11
ANODE GAS
(INLET)
16
CATHODE
EXHAUST GAS
(INLET)
23
14
17

FIG.4


CONCENTRATION OF PURGED HYDROGEN
AT CATHODE GAS OUTLET
B
A
0
0
TIME